

## The Need for a Thermal Band on Landsat

### Summary

1. The availability of thermal data from satellites, especially Landsat, has enabled the development of energy balance models that compute and map evapotranspiration (ET). This application is the first important use of Landsat thermal data, and it has the clear potential to grow dramatically.
2. The use of Landsat thermal data since 2000 has been driven by
  - a. the lowering of costs for Landsat images by a factor of 10 since 1999;
  - b. removal of copyright restrictions on Landsat data;
  - c. successful research in developing dependable processes for computing ET from satellite images;
  - d. the need for ET data by state water resources entities such as the Idaho Department of Water Resources.
3. The current ET mapping in Idaho, Utah, Wyoming, Montana, Washington, New Mexico, Texas and Nevada and California requires the relatively high resolution of Landsat satellites (30 meter short-wave pixels, 120 meter thermal pixels) as opposed to MODIS or AVHRR) to identify ET from individual fields for purposes of water rights and irrigation water management. The ET mapping process requires the consistent return time and coverage of the Landsat system (as opposed to ASTER, which is intermittent at best). In addition, the process requires the high resolution thermal imager of past Landsat systems.
4. With the damage to Landsat 7, we are now down to one single high-resolution, continuous coverage, thermal-sensor equipped satellite (Landsat 5) and, since December 2005, its ability to continue to generate operational power is questionable;
5. Alternatives to Landsat (MODIS, ASTER, AVHRR) are unsatisfactory for operational ET mapping because of limited data availability and/or pixel sizes that are too large to resolve individual irrigated fields.
6. High-resolution, continuous coverage thermal data are essential for mapping evapotranspiration in the U.S. in order to
  - a. quantify actual use caused by evapotranspiration of irrigation water;
  - b. monitor ground-water pumpage by individual landholders;
  - c. mediate and mitigate water rights conflicts and impacts of water transfers;
  - d. solve endangered species issues related to water resources;
7. Several states besides Idaho are beginning or considering a substantial application of SEBAL, METRIC or related procedures for quantifying ET from satellite including New Mexico, Texas, California, Wyoming, Colorado, Florida, and Nebraska.
8. Although a cryogenically-cooled thermal instrument is heavy and expensive, a microbolometer thermal system is neither. Third-generation microbolometer technology is commonly used for many applications, including on unmanned aerial vehicles.

9. A short term solution could be the establishment of a ground-station for downloading image data from the Sino-Brazilian CBERS satellite system that has spatial resolution and thermal band similar to Landsat.
10. We need a working Landsat system that is at a minimum
  - a. One fully functional satellite;
  - b. The satellite equipped with at least one thermal sensor with 120 m pixels.
11. The ideal Landsat system is:
  - a. An array of two to four Landsat satellites
  - b. Each satellite equipped with at least one thermal sensor with 60 meter pixels.

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